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forest MANAGEMENT *bulletin*

GROWTH OF UNDERSTOCKED SOUTHERN PINE STANDS

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Many small landowners clearcut their understocked stands and let nature take its course, or replant at considerable expense. All too often they liquidate stands that have a great potential for profitable growth if well managed. This bulletin presents data illustrating how well some understocked stands have grown under management.

All-aged stands. — Cutting to a diameter limit in the loblolly-shortleaf pine type generally results in badly understocked stands when most, if not all, of the sawlog portion is cut. In table 1, the stocking and growth of six stands cut back to 11.5 inches (29.2 cm) d.b.h. are shown. Some of the competing hardwoods had been cut at the time of the diameter limit cut. Where there were 18 or more pulpwood-sized trees just below sawlog-size, growth has been excellent — something well worth noting when preparing management plans.

In addition, 10-year growth records are available on 20 stands, half of which had been managed by using group selection and half by using single tree selection. Board-foot volume¹ per acre ranged from 766 to 5,432 and averaged 2,952. The average stand after cutting consisted of twenty-two 6- to 8-inch (15.2 to 20.3 cm) trees, fourteen 9- to 11-inch (22.9 to 27.9 cm) trees, and twenty 12-inch (30.5 cm) and larger trees. Helped somewhat by two hardwood removal treatments, average growth during the 10-year period was 373 board feet per acre. Because there was little difference in the growth between the cutting treatments, data from all 20 plots were used to develop the following regression equation in which Y = board foot growth (International 1/4-inch rule) per acre per year and X = volume per acre following cut:

$$Y = .1057X + 60.67 \quad \text{See figure 1.}$$

Table 1.—Stocking and growth following a diameter limit cut

Stand Number	Residual Stand		Residual volume* in trees 12" and larger	Annual growth per acre
	4"-9" d.b.h.	10" + d.b.h.		
1	50	38	2,956	390
2	24	12	800	221
3	25	28	2,418	459
4	103	9	236	193
5	75	12	360	175
6	62	18	669	280

* International 1/4-inch rule

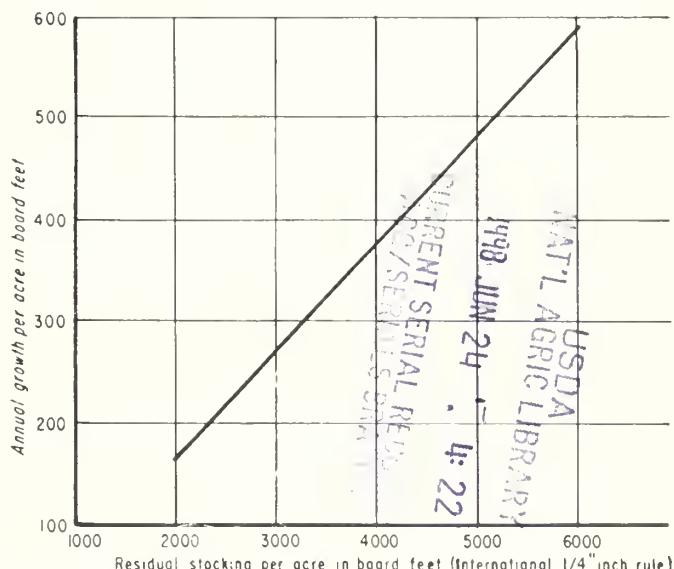


Figure 1.—Annual growth of uneven-aged loblolly pine.

¹ Unless otherwise stipulated all board-foot volumes are for the International 1/4-inch rule.

Even-aged loblolly.—A forester drastically thinned a fully stocked stand of old-field loblolly at age 18 on site 93 near Urania, La. He left 100 trees per acre (247/ha) averaging 7.5 inches (19 cm) d.b.h. and 31 square feet of basal area per acre (7.12 m²/ha). The stand was thinned again when it reached ages 44 and 49, when the basal area was approximately 100 square feet per acre (22.96 m²/ha). At age 54, the remaining 52 trees per acre (128 per ha) averaged 17.25 inches (43.8 cm) d.b.h., and the total yield – including thinnings – was 27,240 board feet per acre. Two plots in the same stand that had been periodically thinned averaged 16 inches (40.64 cm) d.b.h., at age 54. The yield was approximately 37,750 board feet per acre.

Planted loblolly pine.—Near Crossett, Ark., a forester thinned back some plots to 100 trees per acre in a loblolly plantation, site index 90, at age 9 or 12. These heavily thinned plots were given 3 and 2 subsequent thinnings, respectively, and the understory hardwood competition controlled from age 19. Additional plots were thinned to 85 square feet per acre (19.52 m²/ha) periodically, beginning at age 18. At age 30 years, total yield of the two heavily thinned treatments was nearly 16,000 board feet per acre. The residual trees averaged 17.0 and 16.0 inches (43.18 and 40.64 cm) d.b.h. respectively. Yield from the conventionally thinned plots was about 7,000 board feet per acre and the residuals averaged 11.2 inches (28.45 cm) d.b.h.

The question is often raised as to what the minimum acceptable survival of planted loblolly should be. Here, in table 2, are data on the growth of some understocked plantations. Judging from this, 250 to 300 per acre (618-741/ha) well-spaced seedlings at the end of the first growing season should be adequate.

Table 2. Stand characteristics of several understocked loblolly pine plantations.

Location	Age	Surviving trees	Height	Volume	Basal area	Average d.b.h.
	years	no.	feet	cds/acre	ft ² /acre	
Alabama	14	154	41	13.4	63	8.7
	14	260	42	17.9	85	7.7
	14	418	40	19.7	91	6.3
South Carolina	15	285	50	23.4	125	9.0
	15	421	50	26.6	140	7.8
Louisiana	17	214	47	16.3	95	9.0
	17	327	47	19.8	109	7.8
	17	446	47	22.1	123	7.1

Planted slash pine.—A study in Florida shows that 200 surviving slash pine per acre (494/ha) will produce 57 to 64 percent of the 1,000-tree yield at age 20, and 60 to 69 percent of the 1,000-tree yield at age 25. On site quality 70 (height at age 25) 1,000 trees per acre (2471/ha) yield 55.1 cords (289 m³/ha) at age 25, while 300 trees (741/ha) yield 39.9 cords (209 m³/ha) or 62 percent of the 1,000-tree yield. Further, 400 trees (988/ha) produced 46.7 cords (245 m³/ha) or 85 percent of the 1,000-tree yield.

Second-growth slash pine.—A set of variable-density yield tables for natural slash pine stands that have been thinned one or more times was developed by Bennett. Projected cubic- and board-foot yields for a stocking level of 50 square feet of basal area per acre (11.48 m²/ha), the lowest stocking given, are shown in table 3.

Table 3.—Projected board-foot and cubic-foot yields with associated basal area yields.*

From age	To age	Site index					Projected basal area
		60	70	80	90	100	
-----board feet----- ft ²							
20	20	0	0	0	1,306	2,664	50
	30	0	0	3,111	6,060	8,805	76
	40	0	2,135	6,582	10,773	14,676	94
	50	0	4,117	9,608	14,785	19,606	106
30	30	0	785	2,936	4,963	6,850	50
	40	0	2,333	5,691	8,856	11,803	68
	50	0	3,939	8,326	12,461	16,311	83
40	40	0	2,371	4,906	7,269	9,521	50
	50	78	3,709	7,212	10,515	13,590	64
-----cubic feet-----							
20	20	652	871	1,083	1,282	1,468	50
	30	1,318	1,761	2,189	2,592	2,967	76
	40	1,874	2,504	3,112	3,685	4,219	94
	50	2,315	3,093	3,843	4,551	5,210	106
30	30	906	1,211	1,505	1,782	2,040	50
	40	1,415	1,891	2,350	2,783	3,185	68
	50	1,849	2,470	3,070	3,635	4,162	83
40	40	1,069	1,428	1,774	2,101	2,405	50
	50	1,477	1,973	2,452	2,904	3,324	64

* 50 square feet basal area

Planted longleaf pine.—Researchers thinned longleaf pine plantations on site 80 near Alexandria, La., to basal areas of 60, 80, and 100 square feet per acre (13.77, 18.37,

22.96 m²/ha) and to 100 trees per acre (247/ha) at age 20. Ten years later they reported the total yields as follows:

Basal Area ft ² /acre	m ² /ha	Total yield			
		Age 20		Age 30	
		Cds/acre	m ³ /ha	Cds/acre	m ³ /ha
60	13.77	16.0	23.5	35.5	186
80	18.37	17.4	25.5	40.6	213
100	22.96	21.2	31.1	48.3	253
100 trees/acre (247/ha)		11.2	16.4	23.8	125

Second-growth longleaf pine.—A longleaf pine stand with a site index of 75 in Pearl River County, Miss., was badly understocked at age 26 (table 4). In 9 years, volume doubled to a respectable 21 cords per acre (110 m³/ha).

Uneven-aged longleaf pine.—A longleaf stand near Brewton, Ala., with only one-third of the area stocked with pine, was placed under management. The initial volume per acre was 3,525 board feet (1,825 board feet under the Doyle rule) or 11.8 cords (62 m³/ha). Scrub oaks were controlled; bare areas were prescribed-burned to help establish longleaf pine seedlings; and annual cuts were initiated in which less than the growth was removed. Growth per acre over a 10-year period averaged 242 board feet *under the International 1/4-inch rule*, (138 board feet under the Doyle rule) or 0.6 cord (3 m³/ha) annually. Furthermore, many of the quality longleaf pines will make poles, for which premium stumpage is paid.

Second-growth shortleaf pine.—In 70- to 80-year-old shortleaf pine stands under management in north Mississippi, annual board-foot growth per acre (Y) over a 10-year period was correlated with the basal area per acre left after cutting to a highly significant degree, (Y = 5.25 X + 18). Stands with more than 35 square feet (8.04 m²/ha) of residual basal area grew at the rate of 200 board feet per acre or more per year. In somewhat similar stands in the same area, in which all of the hardwoods were left to compete with the pine, growth of the pine was only 60 to 70 percent as much as that of the managed stand. See figure 2.

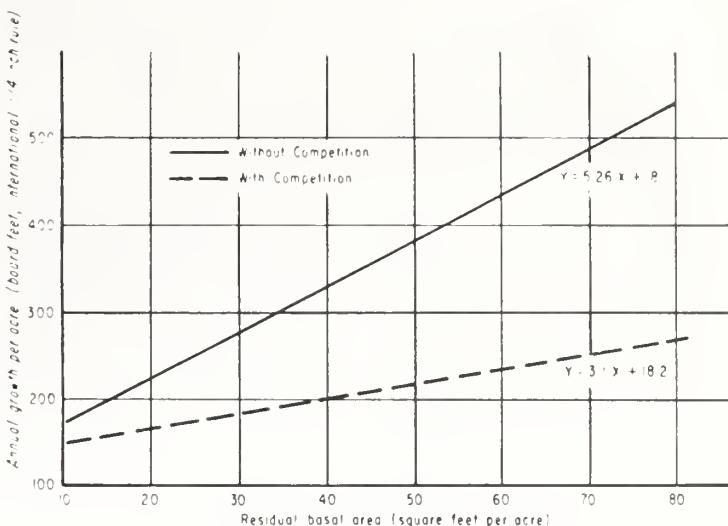


Figure 2.—Growth of shortleaf pine with and without competition from hardwoods 4 inches (10 cm) d.b.h., and larger.

All Species.—Some of the best growth data available is from stands that have been cut back to seed trees or to a shelterwood (heavy seed tree). For example, where longleaf pine has been cut to a shelterwood of 30 square feet (6.89 m²/ha), as was done at Brewton, Ala., you can expect to achieve growth of 150 to 200 board feet. Selected data for three other major southern pines are given in table 5. In these sparse stands, growth losses due to insects, lightning, and windthrow are accentuated. In the loblolly study, one seed tree per acre was lost every 5 years; in the shortleaf study, one seed tree in 10 was lost every 10 years. Losses in the longleaf shelterwood averaged less than one tree per 5 acres, each year. And, in the slash pine, losses to lightning were less than 1 percent per year. At the time these studies were installed, it was customary to harvest the seed trees only after pine reproduction was relatively fireproof or at the time of the first pulpwood cut. Now the policy generally is to cut when the reproduction is but 2 or 3 years old. At that age, logging does less damage; board-foot losses from lightning strikes can be substantially reduced; and if a burn occurs the area can always be replanted.

The message should be clear. Frequently, even despite mismanagement, enough growing stock is left to

Table 4.—Some characteristics of a second-growth, south Mississippi, longleaf pine stand.

Age	Trees per acre				Average d.b.h. inches	cm	Basal area 4+ inches		Volume 4+ inches per acre	
	4 --- inches	4-8	9+	total			ft ² /acre	m ² /ha	rough cords	m ³
26	62	104	34	200	6.3	16.0	41.4	9.5	10.2	54
35	44	66	80	190	8.0	20.3	65.4	15.0	21.1	111

sustain a good rate of growth. Most pulpwood-size loblolly and shortleaf pines will more than double their cubic volume and small sawlog-size pines will nearly triple their board foot volume in 10 years. One hundred 6-inch (15.24 cm) loblolly pines per acre freed from all competition will produce 10,000 board feet per acre in 20 years. It would be foolhardy to prescribe further liquidation. The residual trees should be evaluated according to their number, size, species, and distribution. Because of the diversity of situations that may occur it is impossible to draft rough guidelines. The judgement of a professional forester is needed. Where there are sufficient trees to warrant management, control of the competing vegetation should be prompt and complete.

Table 5.—Annual growth of stands cut back to seed trees or a shelterwood

Species	Location	Trees left 10" d.b.h. (25.4 cm) and larger		Growth no./acre no./ha board feet ^{1/}
		no./acre	no./ha	
loblolly	Crossett, Ark.	12	30	150
		13	32	193
shortleaf	Abbeville, Miss.	13	32	47
		13	32	38
		24	59	180
		23	57	134
slash	Alexandria, La.	5	12	662/
		10	25	1322/
		20	49	2632/

1/ International ¼-inch rule

2/ Rough conversion from cubic volume growth per acre per year

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OTHER SOURCES OF INFORMATION

Eighteen additional forest management bulletins have been published by the Forest Service's Southeastern Area, State and Private Forestry, since 1971. The titles, and directions for ordering copies, are in the Southeastern Area's catalog, *Publications for the Forest Land Manager and User of Forest Resources in the South*. Other publications pertinent to forestry in the South are also included in the catalog, which lists about 175 titles. The 1977 Supplement to the catalog lists 44 additional publications. Copies of both the catalog and the 1977 Supplement are available without charge from: Information Center, USDA Forest Service, 1720 Peachtree Road, N.W., Suite 904A, Atlanta, Ga. 30309.

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